# Light and Lighting

Vol. XLIII.—No. 12 December, 1950 One Shilling

## Contents



*Publishing Offices :—32, Victoria Street, London, S.W.1. Telephone ABBey 7553. Published monthly. Subscription rate £1 per annum. The official journal of the Illuminating Engineering Society.*

# About Ourselves

THIS year we have set out to enlarge and improve our Journal, and with the present number the first volume of LIGHT AND LIGHTING in its new form is completed. For our part we are not displeased with what has been achieved, though not all our ambitions have yet been realised. We believe many of our readers are gratified by the improvements we have been able to make, and the expressions of approval which we have received are encouraging and stimulating. Unfortunately, enlargement of the Journal has necessarily involved higher costs of production, and if we are to maintain the new standard we have set an increase in price is unavoidable. The new price—1s. 6d. per copy—which we are compelled to adopt as from January, 1951, is no higher than that of various other specialised Journals, and we venture to think we shall be giving as good value for money as they. Readers of long standing may remember that the Journal was priced at 1s. 6d. 30 years ago and although, subsequently, the price before the war fell as low as 9d., we believe our readers will appreciate that in present circumstances 1s. 6d. is not too high a price for the new LIGHT AND LIGHTING.

# Notes and News

## *Trotter-Paterson Memorial Lecture*

The first Trotter-Paterson Memorial Lecture is to be given at the Royal Institution, Albemarle-street, London, W.1, at 6 p.m., on Wednesday, January 17, and will be given by Dr. J. W. T. Walsh, who has chosen as his subject "The Early Years of Illuminating Engineering in Great Britain."

The lecture has been founded by the Illuminating Engineering Society in memory of two of its most distinguished past-presidents, Mr. A. P. Trotter and Sir Clifford Paterson. As they were both pioneers on lighting in this country Dr. Walsh's lecture will no doubt dwell upon their contributions to the considerable industry which has developed since they first entered the lighting field. The fact that the lecture is to be given at the Royal Institution adds considerable dignity to the occasion.

The lecture is open to the public and admittance will be by ticket only. This ruling applies both to I.E.S. members and others. Tickets may be obtained from the I.E.S. Secretary, 32, Victoria-street, London, S.W.1.

## *Next I.E.S. Meeting in London*

The next I.E.S. meeting in London will take place at the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, at 6 p.m. on December 12.

At this meeting a lecture on "The Development of the Tungsten Lamp" will be given by Mr. B. P. Dudding. The lecture will review the technical advances made during the last 30 years and the development of essential raw materials such as glass, special alloys and filaments, and will refer to some of the major changes in processes during that time.

## *The House of Commons*

Our interest in the lighting of the new House of Commons led us to delve into the history of lighting in the House. In the course of our search we unearthed the minutes of a committee set up in 1852 to report on the ventilation and lighting of the House. The building in question was the one which was destroyed in 1941 and had at that time only just been completed. It appears that no sooner had the Members of that day occupied their new home when they found fault with the ventilation. As it was claimed that the products of combustion from the gas burners in the chandeliers which illuminated the chamber vitiated the atmosphere the committee was set up to enquire into the business and to report as early as may be.

The minutes of evidence make interesting, though at times somewhat heavy, reading. They show that the ways of committees have not altered very much in nearly a hundred years. (We notice, however, that the committee usually met at twelve, twelve-thirty or even one o'clock to begin their deliberations and to examine witnesses, a time of day which would hardly be popular with any modern committee or witness.)

The witnesses included the architect of the House and a number of engineers and a variety of schemes and methods of lighting were put forward and discussed. There were a number of complaints of headaches due to the gas lighting, and one gentleman from the Press gallery complained that working on eye level with the chandeliers "the pain to the brows was quite serious." We feel sure that the glass manufacturers of the day must have been rather upset by the witness who stated that after carrying out thousands of observations he had concluded that light was infinitely less trying

to the eye when it did *not* come through glass. An idea which the glass manufacturers no doubt abandoned very quickly was that put forward by a very eminent politician who suggested in connection with the scheme for lighting from above a laylight that the light should be softened by passing through two plain layers of glass filled with coloured water. The idea was demonstrated to a full House and approved—until someone forsaw what might fall upon the heads of honourable Members.

It is of interest to note that even in 1852 the phrase "quantity and quality" of light was in use. It is not clear what "quality" embraced, but as the light sources under discussion were various combinations of oil, gas and oxygen or air it is possible that any consideration of quality also included the amount of noise made by the burners. It is probable, however, that even in those days they meant colour.

By continuing the general design of the former Chamber in the new building it would seem that the architects have had to consider many similar problems. One of these is lighting under the galleries which we should imagine has now been dealt with in a much more satisfactory manner than was possible in the House of 1852. Though many Heath Robinson gadgets were suggested for throwing, refracting or projecting light under the galleries of the old House, we are not clear whether the problem was solved, and have a feeling that formerly the back benchers could feel pretty safe; in the new House under the gentle glow of the "warm white" under gallery lighting they will probably be rather more conspicuous.

We note that in those early days it was necessary, when required to light the Chamber, for an attendant to enter the Chamber for this purpose. This was, no doubt, distracting to hon. Members, and we wonder whether this has any bearing on the emphasis which has been put on the need for a carefully controlled dimming system in the present House. The point of the dimmer control in the present House is not at all obvious. During the winter months the lighting will probably be on the whole time the House is sitting, though in any case the distraction value of the lights being switched on in such surroundings where the main light sources are well above eye level is surely negligible.

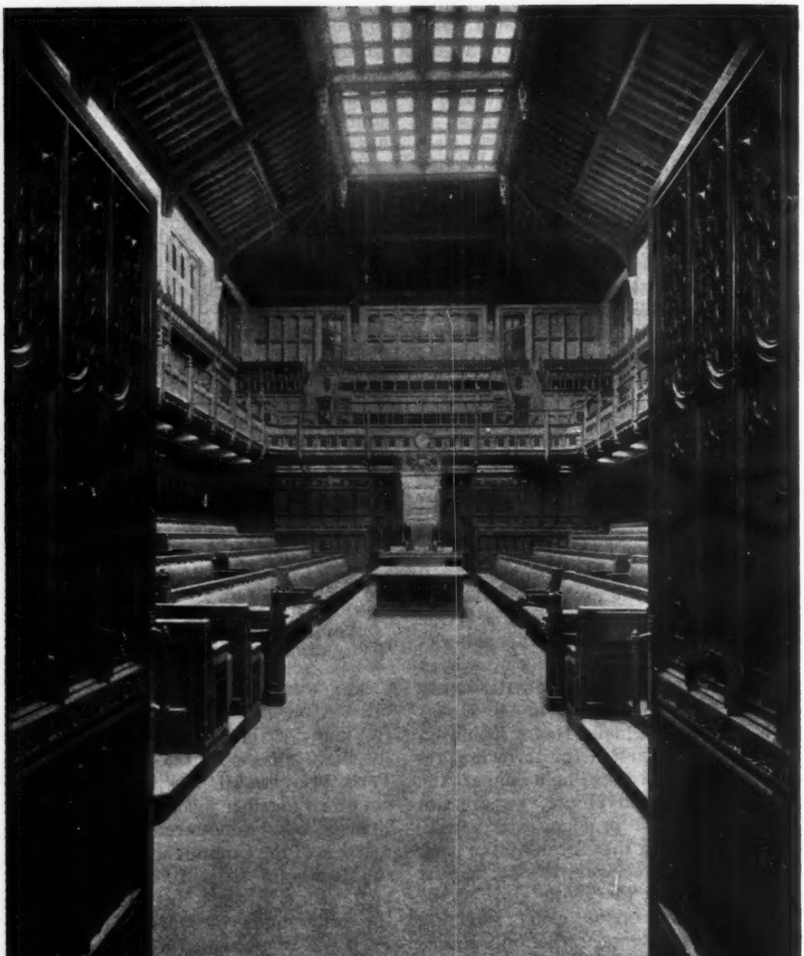
The lighting in the new Chamber has come in for some criticism, according to the national Press, in connection with its colour. We spent quite a time in the Chamber looking at the lighting from many aspects and were not at all conscious of any objection to the colour. The criticisms we have read have in our opinion been unfair. Matters do sometimes tend to get distorted in the Press; even a newspaper like "The Times" in its Survey of the House of Commons in describing the amenities for Parliamentary Reporters states that "neon lighting diffuses its warm effulgence everywhere." No doubt the lighting is warm; it's rather an effort but we can even swallow "effulgence"; but "neon"!—well we are surprised.

## *International Commission on Illumination*

The work of the International Commission on Illumination was interrupted for many years by the war, and one of the main objects of the 1948 meeting in Paris was to get the various member countries together again.

It is now announced that the next meeting of the Commission will take place in Stockholm from June 26 to July 5 next year. At this meeting reports on the programme of work laid down in Paris will be presented by the responsible countries. In addition to these reports on progress and development between 25 and 30 papers, of which eight are by authors from this country, are to be given.

Delegates to the meeting are appointed by the National Illumination Committee. Anyone may, however, attend the meeting as a visitor; details may be obtained from the Illuminating Engineering Society, 32, Victoria Street, London, S.W.1.



***View of the Debating Chamber of the House of Commons looking towards the Speaker's Chair from the Commons' Lobby.***

# Lighting in the House of Commons

**This lighting installation, which has been the subject of much comment since the opening of the new House of Commons, is the result of close co-operation between the lighting engineer, architect, and consulting engineer. This article describes the system and equipment used.**

The lighting installation in the new House of Commons, where Members of Parliament assembled for the first time on October 26, is an outstanding achievement in the application of modern illuminating technique to a famous building which designedly retains the traditional atmosphere of its predecessor. This project has been devised and carried out by The General Electric Co. Ltd., in close collaboration with the architect, Sir Giles Gilbert Scott, O.M., R.A., and the consulting engineers, Dr. Oscar Faber and Partners.

### Lighting in the Chamber

The main lighting of the Chamber is entirely by means of fluorescent lamps, both hot and cold cathode, all of which are controlled by a dimming system that enables the illumination to be increased gradually to the level desired so that Members are not disturbed by the sudden switching on of the lamps.

The principal source of lighting in the Chamber is provided by 150 cold cathode units mounted in the ceiling above a laylight. The five main panels of the laylight are each subdivided into 30 smaller panels, and the whole laylight and its subdivisions is framed in carved oak. A cold cathode unit is mounted behind every ceiling panel. The glazing of the panels is tinted oak colour so that by day the whole roof appears to be of timber.

Each cold cathode unit consists of a sheet steel casing divided into two compartments, the lower one containing the intermediate white cold cathode tubing, and the upper one the gear. The tubing, wound into spiral form, is 14 ft. 8 in. long and is supported on glass insulators. At each end of the spiral the electrodes are turned upwards to project into the gear compartment. The lower section of the casing is lined internally with glass mirror reflectors, while the bottom is formed by the tinted glass panel.

The operating voltage for the unit is obtained from a transformer with secondary wound for a maximum normal lamp current of 120ma. A transductor in the primary circuit enables the mains input to the transformer to be varied and thus enables the lamp current to be regulated. The D.C. for the transductor is provided by a metal rectifier in each unit, accommodated in the gear chamber together with the transductor itself, the transformer, and power factor capacitor. Dimming is carried out by varying the A.C. input voltage to the rectifier and hence the saturation of the core of the transductor. This operation is centralised in the plant room adjacent to the ceiling of the Chamber, where two motor-driven potentiometers each control the A.C. feed to a different group of cold cathode units, one group lighting three and the other two of the main ceiling panels.

The cold cathode units have plug and socket connections with the mains so that they can be removed easily for cleaning or replaced with a spare unit if necessary. A double-pole interlock safety switch is incorporated with the top cover of each unit, ensuring that the transformer is connected to the mains only when the cover is

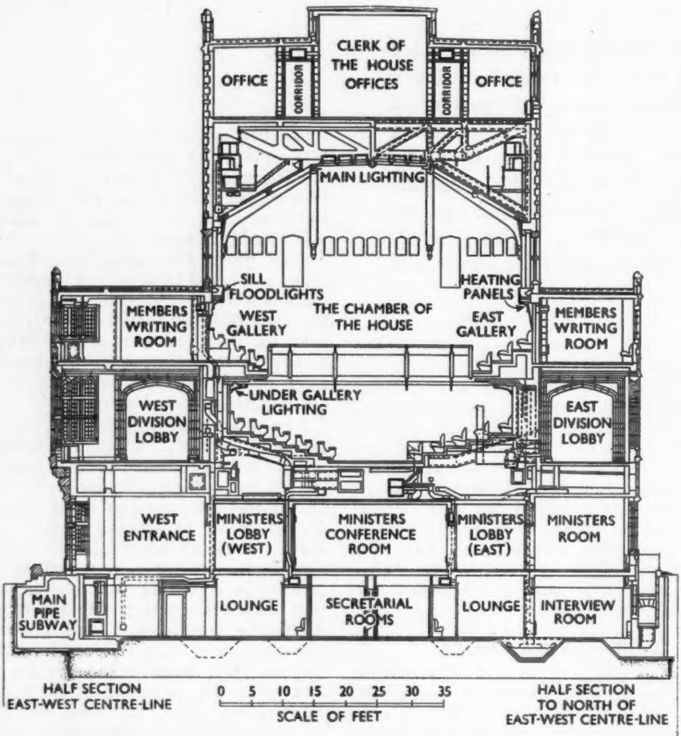
correctly in place. Replacement of the tubing should be necessary only at very long intervals, as the estimated life is 10,000 hours.

### Sill Lighting

In order to light the whole roof uniformly and to avoid undue contrast between the central laylight and the sloping sides, five lighting units are mounted on the window-sills at each side of the Chamber. Each unit contains two 8-ft. hot cathode 125w. natural colour lamps, arranged in front of a parabolic reflector so as to direct the light on to the slope of the roof above them. The dimming arrangements for these lamps, as for the under-gallery lighting described later, are the outcome of extensive experimental and development work. That the relatively new development of dimming hot cathode lamps should have been adopted on such a scale and in a building of such high national importance is itself a tribute to the success with which the architect's stringent requirements have been satisfied.

Each lamp is operated from the mains through a leaky flux transformer with separate windings for providing the starting voltage and the filament-heating current. A transductor connected between the transformer and each lamp provides for dimming, the D.C. winding being connected to a motor-driven potentiometer in the dimmer panel which controls the input to all 20 transductors in the sill lighting system. The position of the transductor in the circuit enables it effectively to impede the flow of lamp current without exerting any undesirable influence on the open circuit voltage necessary for stable operation.

The sill lighting units are equipped with louvres to prevent direct view of the lamps




**Sectional diagram of the House of Commons, showing layout of lighting equipment in Chamber and arrangement of premises on other floors.**

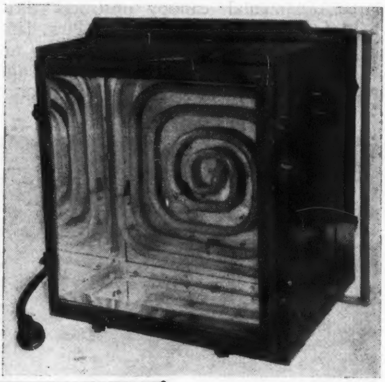
from certain seats in the two end galleries. In conjunction with the reflectors, the louvres also prevent unwanted light from falling on the sides of the windows and on the open carved wood cresting running along the front of the sills. Glass dust covers are fitted to all units.

**Under-gallery Lighting**

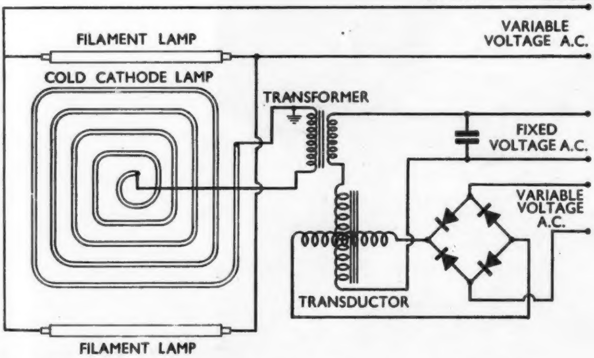
Although light from the ceiling units reaching the back benches under the galleries is sufficient for reading, the partial screening effect of the galleries would make it difficult for the Speaker to see the faces of Members occupying these seats. A line of 2ft. 20w. fluorescent lamps therefore runs round all four sides of the Chamber in a recess on the underside of the front of the galleries. The lamps are mounted end to end behind "Perspex" covers tinted to match the woodwork. Any lamp can be removed individually without disturbing the "Perspex" screening over adjacent lamps. All the 72 fluorescent lamps in this system are dimmer-controlled. Each pair has its own set of control gear, housed in boxes recessed in the gallery floor. The two rectifiers which provide D.C. for the transductors in the under-gallery and sill lighting circuits are adjacent to the plant room. A separate motor-driven potentiometer controls the D.C. output from each rectifier.

An emergency lighting system in the Chamber is supplied from storage batteries and is always on when the main lighting is in use so that even in the event of a mains failure the Chamber would remain illuminated. There is one emergency lamp between each pair of under-gallery lamps, concealed by the same "Perspex" enclosures, and additional lamps under the sills.

The two fluorescent lamp colours used in the main Chamber lighting produce a mellow sunlit effect without distorting the colour of the woodwork.



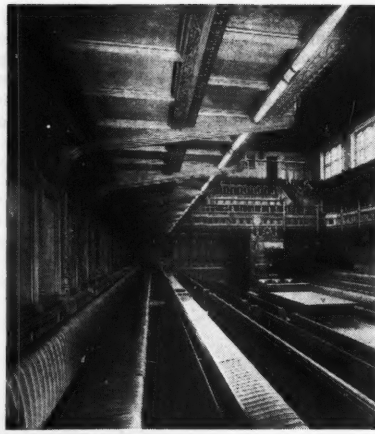
General view of one of the cold cathode fittings used above the laylight of the Debating Chamber.



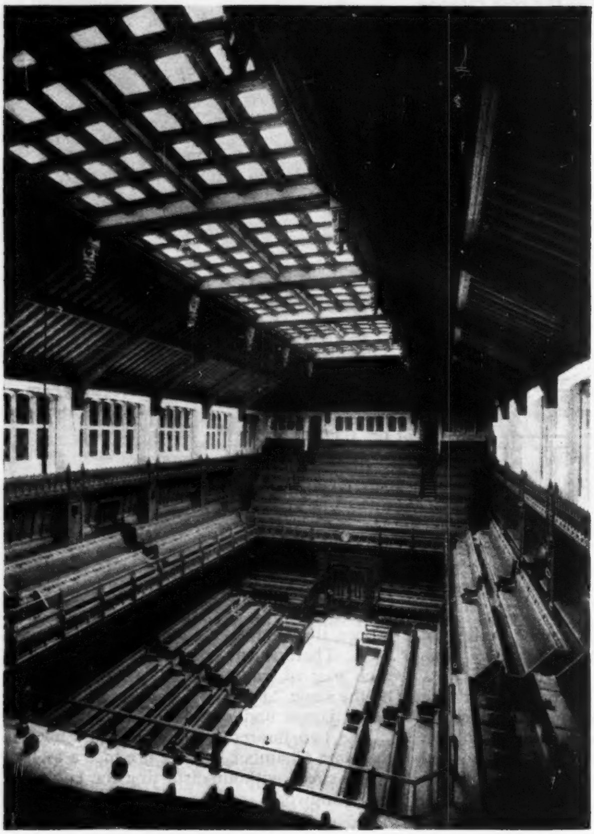

Circuit diagram for cold cathode fitting.

### The Speaker's Chair

While the architecture and decoration of the Chamber have been planned with less profusion of armament than in its predecessor, although retaining and even enhancing its traditional atmosphere and dignity, the Speaker's Chair is an exact reproduction of the one destroyed in 1941. A replica of this chair exists in the Parliament House at Canberra, Australia, and this has been copied in the new chair for the House of Commons. An independent light source has had to be provided in the chair, since its large ornamental canopy obstructs direct light from the ceiling. A 2-ft. 20w. lamp is concealed in the top of the canopy and is controlled by its own motor-driven dimmer, which is mounted below the floor of

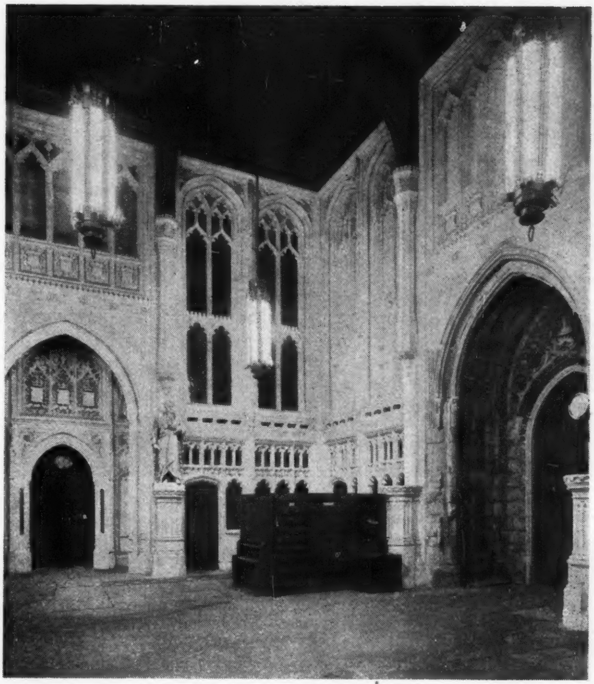


*(Above).* Part of the continuous line of fluorescent lamps which runs around all four sides of the Chamber under the galleries.

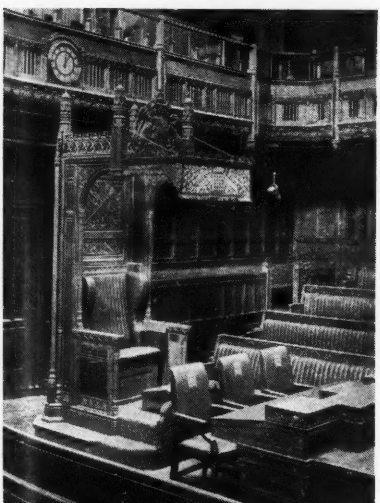


*(Left).* View from the gallery showing the lighting of the slopes of the roof and walls by lamps on the window sills concealed by carved wood.

*(Right).* The Members' lobby showing the Churchill Arch on the right.



*(Below).* The Speaker's Chair. A 2-ft. 20-w. fluorescent lamp is concealed in the canopy.

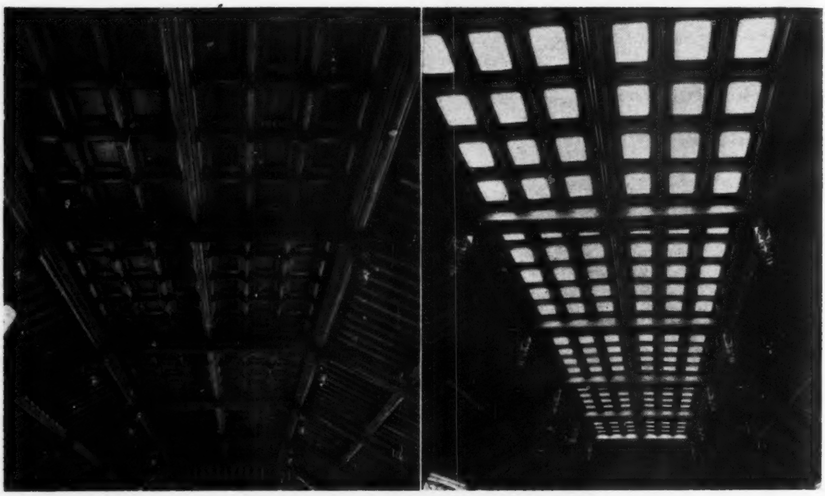


the Chamber. A switch fitted in one of the arm-rests of the chair enables Speaker to have personal control of the lamp, both for switching on and off and regulating its intensity.

**Dimmers and Control Panels**

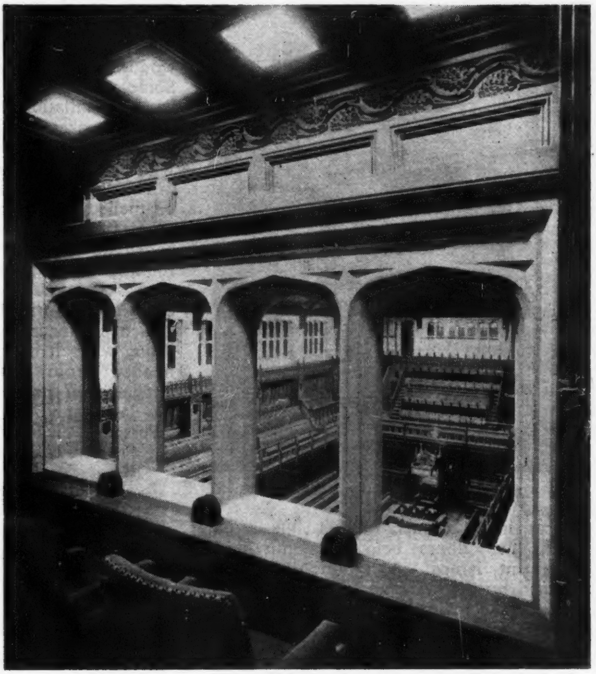
Control of the Chamber lighting is normally effected from the engineer's control room in the basement of the House. Push-button switches for remote control of the motor-driven dimmers are mounted on a panel beside the engineer's desk, enabling the illumination to be increased or decreased as necessary. Indicator instruments are recessed into the panel to show the intensity of the main ceiling lighting, while coloured pilot lights show when the lamps under the galleries and in the sills are alight. The engineer controls other services in addition to lighting, and watches the Chamber through a periscope running up through four floors to a vantage point in the Chamber.

The dimmers themselves are installed



Day and night view of the laylight in the Chamber.

One of the Divison Lobbies

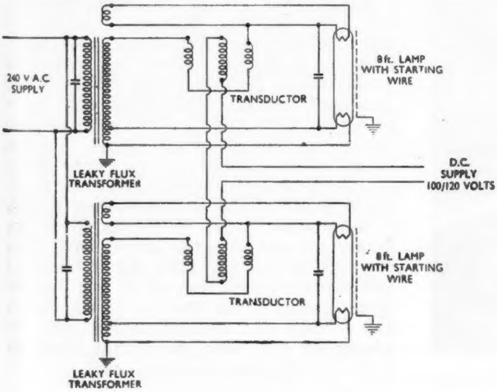


View of the Chamber from the Speaker's special strangers' gallery.

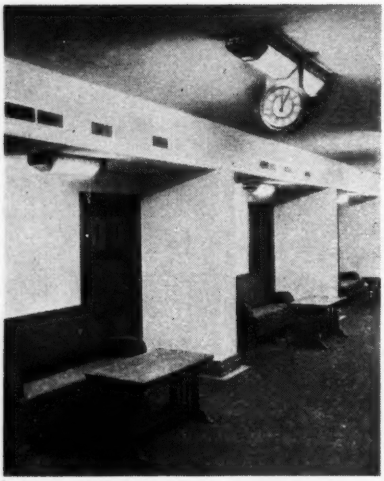
in sheet-steel cubicles in a plant room on the same level as the ceiling of the Chamber. They are four in number, two carrying the control of the cold cathode units in the ceiling laylight, while the other two regulate respectively the under-gallery and the sill lighting. Each dimmer motor is controlled by three push-buttons, two for starting it in either direction of motion, and the third for stopping the motor at any intermediate position. The motors are geared to bring the lighting up from zero to full in one minute. Although there are individual sets of push-buttons for the two ceiling dimmers, they are located conveniently for operating both motors together by pressing the corresponding buttons simultaneously. These controls duplicate those on the engineer's panel, and similar indicators and pilot lamps are included The plant room control panels are mainly for convenience in testing the equipment. Provision is also made for disengaging the motor drive and operating the dimmers by means of handwheels.

### Lighting of the Precincts

The lighting in the Division Lobbies and writing rooms adjacent to the Chamber, as



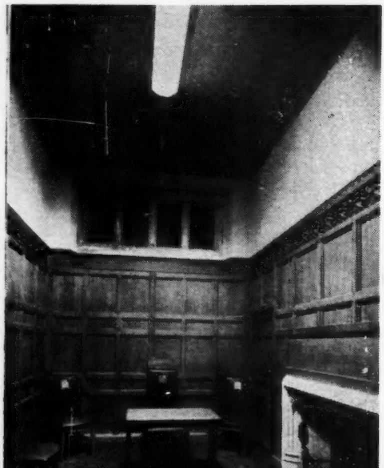

Circuit used for dimming the pairs of fluorescent lamps in the sill lighting system.



The Members' lounge.

well as in all rooms, lobbies, offices, etc., on the two floors below is entirely by fluorescent lamps. A Gothic-style fitting designed by the architect is used in various sizes for the majority of these applications.

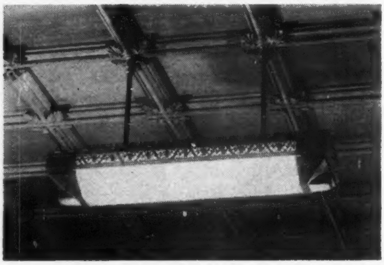
This style of fitting has a body of real



The Prime Minister's Room.

bronze metal, finished in its natural colour. The "Perspex" enclosure for the lamps is tinted oak colour to match the surrounding woodwork when the fitting is not illuminated. Some 400 of these fittings are used in the whole installation, the design being made in different sizes to take two, three or four lamps of the 2-ft. and 4-ft. lengths, some with and some without fretted sides.

The lamps are mounted below a vitreous enamelled reflector, on top of which is the gear tray. This assembly is secured to the backplate of the fitting, but can be lowered for inspection and maintenance. Four nylon cords, anchored to the backplate at the corners, support the assembly at a convenient distance below the body of the fitting when it is released, or it may be unhooked from the cords and removed altogether if necessary. To gain access to the lamps and gear in this manner the "Perspex" enclosure is taken off by slackening the screws which hold the bronze end



Type of fitting used in the Division Lobbies.

covers in the closed position; this allows the covers to swing down and the "Perspex" to be lifted out.

Most of the ceilings are ceiling-mounted, but those in the Division Lobbies are suspended and have fretted sides and battlement ornamentation. Clocks are suspended below two of the ceiling-type fittings in the Members' Lounge. The clocks were made by Messrs. Gent and Co., Ltd., and are fitted into the metalwork of the fittings. Certain other ceiling fittings of the same basic design are arranged to incorporate the ventilation grilles of the air-conditioning system.

Many other types of fittings, both for fluorescent and tungsten lamps, have been produced specially to meet the architectural and structural requirements of this installation. Laylights are fitted in certain offices and lobbies, and are illuminated either by groups of 2-ft. 40w. fluorescent lamps in

(*Continued on page* 446)

# Progress in Glare Evaluation

**Discomfort glare is a subject which has been studied with some interest both in this country and in the U.S.A. in recent years. The author of this article, who is well known for his work on the subject, has endeavoured in the following article to summarise in simple words the present state of our knowledge of this subject.**

By WARD HARRISON

In an address before the I.E.S. at Harrogate two years ago the writer included a brief discussion on direct discomfort glare. (1) Since then, two major contributions to the literature of that subject have become available. The first of these chronologically is "Brightness in the Visual Field at Borderline Between Comfort and Discomfort (B.C.D.)," presented by Luckiesh and Guth at the annual conference of the American I.E.S., September, 1949. (2) The second is entitled "Discomfort Glare and the Lighting of Buildings" by Petherbridge and Hopkinson, presented before the British I.E.S. in January, 1950. (3) Both of these papers are of great value. They contain much that is new and interesting and it would seem worthwhile to compare their points of similarity and their points of difference, and, also, to check them against earlier work. Discomfort glare is just now in the stage where any discussion quickly becomes involved and difficult. However, it is the aim of this article to summarise the present state of our knowledge as simply and, non-technically as possible.

For a single light source in a fixed position in the field of view, the fundamental factors which determine whether or not it will be comfortable are: first, its brightness; second, its size (projected area or solid angle); and, third, the brightness of its surroundings; also, in any practical glare evaluation the question arises as to the effect of additional sources in the field of view.

### Effect of Multiple Sources

It may be well to start with this point on which the investigators seem to be in substantial agreement. Petherbridge and Hopkinson's data lead them to conclude "the glare effect from a number of sources is the same as that from a single source of the same total area." The data shown in Figure 14 of the Luckiesh and Guth paper confirms this conclusion, and their Figs. 15 and 16 would indicate that the glare effect of multiple sources is, if anything, a little worse than for the single source of the same area. The assumption that source areas could be added has been made by Harrison and Meaker in all their glare factor calculations.

### Source Brightness v. Source Area

Holladay's limited investigation led him to the conclusion that source brightness was overwhelmingly more important than source area. In his formula he assigned an exponent of unity to brightness and 0.25 to area. This would mean that doubling source brightness is as serious, from the glare standpoint, as increasing source area 16 times.

Petherbridge and Hopkinson from their researches assign an exponent of 1.6 to brightness and 0.8 to area, relatively the same as unity for brightness and 0.5 for area. These exponents indicate that doubling source brightness is equivalent to increasing source area four times.

Luckiesh and Guth found Holladay's data approximately correct for the range of areas

(1) Trans. Illum. Eng. Soc. (London), Vol. XIII, No. 6, 1948.
(2) Illuminating Engineering, Vol. XLIV, No. 11, 1949.
(3) Trans. Illum. Eng. Soc. (London), Vol. XV., No. 2, 1950.

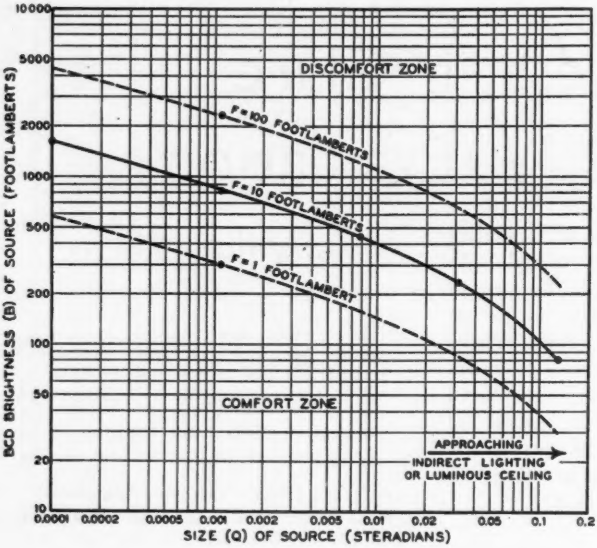



Fig. 1. Relationship between source brightness and source area for border line between comfort and discomfort according to Luckiesh and Guth. The slope of the curves indicates exponent for area when exponent for brightness in unity. (F refers to surround brightness).

he explored but they also found that in the case of larger areas the exponents change rapidly, as is indicated by the change in slope of the curves in Fig. 4 of their paper (Fig. 1 of this article). It will be noted that these curves are plotted on a logarithmic scale and the areas are expressed in steradians. Where the areas are .006 steradians or less, the region explored by Holladay, the slope of the curves is 2½ to 3 parts in 10. That is, the exponent for area is 0.25 or 0.3. Where the source size is .025 steradians, a tangent drawn to the curve will indicate an exponent of about 0.5 and likewise if the area is .06 steradians, the exponent is approximately 0.66.

This brings us to the very practical question—Where do most lighting installations fall? Should they be classified as having small source areas or large source areas? Everyone knows what a steradian is, by definition, but there are few engineers who can look at a lighting installation, or a scheme for one, and come within gunshot of knowing what fraction of a steradian whether .01 or 0.1 the lighting units represent. To clarify the matter in his own mind, the writer undertook the study of a number of lighting photographs. In America, the majority of such photographs, at least by professionals, is on 8 in. x 10 in. plates and commonly with a lens of 8½ in. focal length. The resulting prints run to about 71 sq. in. and, by coincidence, subtend almost exactly one steradian. With a planimeter it is not difficult to measure in square inches the total area of all the light sources that appear in the picture, and that result divided by 71 gives their area in steradians. Some examples are shown here in Figs. 2 to 5 inclusive. No photos of fluorescent lighting that have been measured so far show an area below .025 steradians. According to Luckiesh and Guth data, this means that for most fluorescent lighting, and for much incandescent lighting also, source area carries an exponent of 0.5 or more where the exponent for brightness is taken as unity. This is the same relative weight for area that is shown by Petherbridge and Hopkinson and, also, in the glare factor tables included in the writer's Harrogate paper.

### Source Brightness v. Surround Brightness

Based on limited data, Holladay, gave an exponent of 0.3 to surround brightness where the exponent for source brightness is unity. This means that doubling source brightness has the same effect as a change of 8 to 1 in surround. The more complete Luckiesh and Guth research sets the surround exponent at 0.44, and Petherbridge and Hopkinson find it to be 0.62. The figure 0.44 means that doubling brightness

is equivalent to changing the surround 5 to 1, whereas 0.62 would only mean 3 to 1 to restore the same degree of comfort. There is no obvious explanation of this discrepancy other than the difference in test methods employed. The Luckiesh and Guth appraisals are based on the so-called shock test method, but they claim very definitely that they find no difference in result between this and other laboratory methods of evaluating discomfort glare. They simply find it more expeditious. The Petherbridge and Hopkinson experiments were made with miniature set-ups which might possibly be criticised from the standpoint that near binocular vision rather than far vision was employed. The Luckiesh and Guth surround occupied the entire field of view.

So far, in the Harrison-Meaker glare factor calculations, Holladay's exponent of 0.3 has been employed, and this figure now appears to be too low. However, the writer's experience leads him to believe very definitely that within the range of practical lighting installations the exponent for surround brightness is somewhat less than the exponent for source area. As evidence of this, many cases may be cited where the occupants of unsatisfactorily lighted rooms have declared themselves to be more comfortable when half the luminaries have been turned off, thus reducing surround brightness and source area to the same extent.

**Effect of Immediate Surround**

In Part IV (e) of their paper, Petherbridge and Hopkinson have given some very interesting data on the effect of an immediate surround for light sources at a higher brightness than the general surround, or, as they state it, "a contrast grading between a source and its surround." This is the situation found in almost every electric lighting installation except those employing opaque direct lighting reflectors or recessed troffers. However, so far as the writer can recall, no laboratory data on the subject has been available previously. Petherbridge and Hopkinson show that to be effective in reducing discomort, the area of the immediate surround should ordinarily be several times that of the glare source, and its bright-

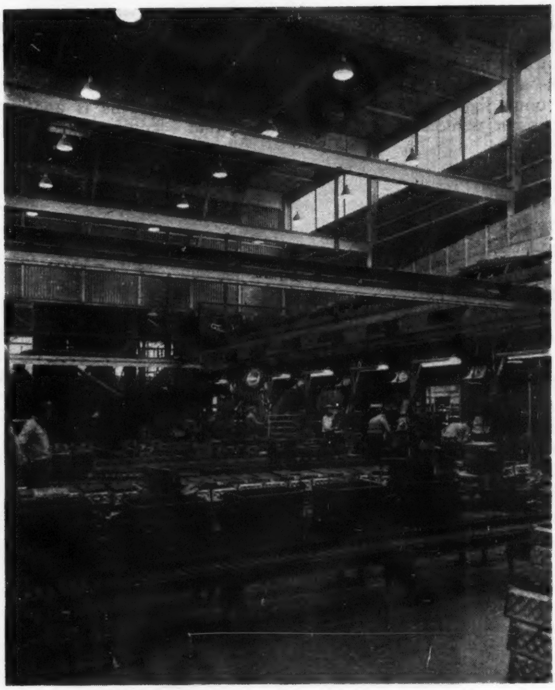


Fig. 2. Deep reflectors over incandescent lamps. Aggregate light source area ·0063 steradians. Indicated exponent for area 0·35 based on curves of Fig. 1.

Fig. 3. Incandescent lamps in diffusing globes. Aggregate area ·043 steradians. Indicated exponent for area 0·5. (Photo made with 6·5 inch lens.)

ness should be somewhat higher than the geometric mean between the source and its general surround. Unfortunately, such conditions are scarcely obtainable in the daytime in rooms lighted by windows. However, in American schools it is often required that the window trim and the entire window wall be painted in a very light colour.

**Position of Light Source in the Visual Field**

This is another important factor in discomfort glare. The Luckiesh and Guth

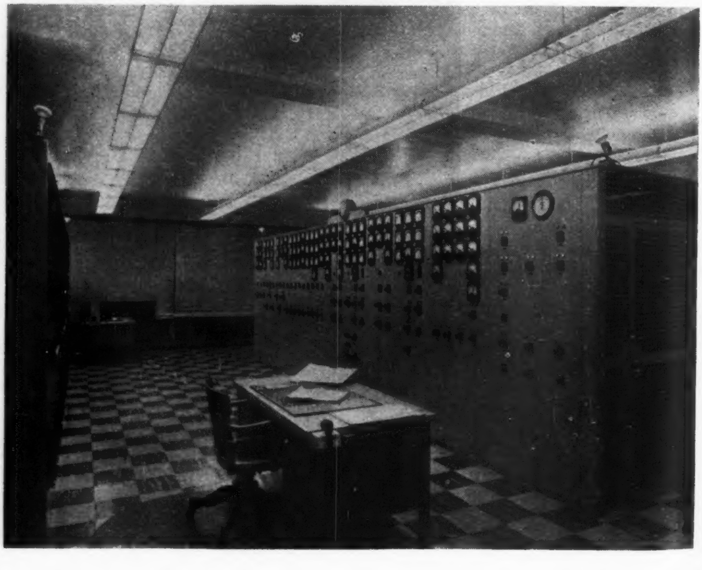


Fig. 4. Direct indirect fluorescent lighting. Aggregate area ·042 steradians. Indicated exponent for area 0·5.

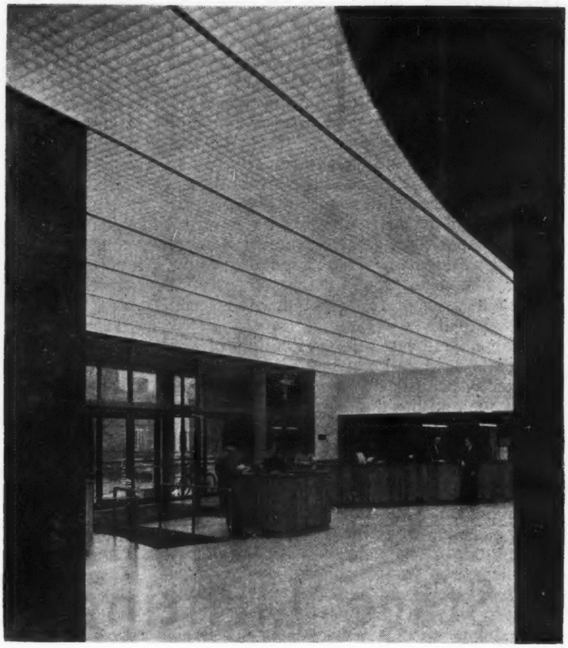


Fig. 5. Louverall ceiling. Aggregate area 0·32 steradians. Indicated exponent for area above 0·7.

data indicate that raising the light source even a few degrees vertically has a marked influence in reducing discomfort, and that the effect of moving it sidewise is very much less. For example, they find that moving vertically 20 deg. is as effective as moving it more than 40 deg. horizontally. The Petherbridge and Hopkinson data do not show any such decided difference between horizontal and vertical displacement and their results, for both fall between the two Luckiesh and Guth curves. It may be that the Petherbridge and Hopkinson data are correct, for an observer fixating very determinedly on a given point relatively close to the eyes, but, in general, experience would tend to confirm the Luckiesh and Guth conclusions. When one is sitting at ease, he will object much less to a source 20 deg. above the line of vision than to one removed 20 deg. to the side, even though he does not look directly at either one.

### Effect of Source Shape

In both of the recent investigations data were taken on the effect of source shape, in particular comparing linear fluorescent lamps with more compact sources. In each instance the former were found somewhat less glaring but the difference might be termed of second degree importance. This is at variance with a report of certain work by Vermeulen and deBoer* which indicates that discomfort glare from linear sources seen crosswise scarcely increases at all with increased length.

### General

It should be kept in mind that the practical objective of all these glare investigations is to enable one to foretell whether or not a proposed lighting installation will be found satisfactory from the comfort standpoint. In view of the very considerable difficulty involved in correctly applying the basic data from glare investigations to specific cases, and, also, because of the great amount of time required for such calculations, it is the opinion of the writer that these matters will scarcely come within the purview of the practising illuminating engineer until the accumulated knowledge, as it applies to specific luminaries, can be made available in tabular form, such as that included in the author's

* To the author's knowledge not yet published.

1948 Harrogate address. In that paper, he indicated that the exponents used were by no means represented as accurate and that more laboratory investigations were needed.

For those interested in the glare factor tables, it may be repeated that the researches by both Petherbridge and Hopkinson, and Luckiesh and Guth indicate that the exponent for surround brightness which has been used in these tables is too low and that, accordingly, the values in Fig. 12 of that paper should be revised, using an approximately 50 per cent. greater exponent. Also, the Petherbridge and Hopkinson data show that immediate surround brightness may be entitled to even more weight than has been accorded to it.

In an actual case, the evaluation of the immediate surround can scarcely be worked out exactly because of the many variables of size, shape and position of the surround that are involved in most lighting installations. To a lesser extent some changes may also be needed in Fig. 11 of the Harrogate paper, which deals with the position of the source in the field of view. However, it would seem that more consistent laboratory data are needed before such a revision is justified.

One's sensation of glare does not increase as rapidly as do the numerical glare factor ratings, and it has been suggested that the ratings be made directly proportional to brightness rather than to source area. This can be accomplished readily if desired, but, again, the relationship between the glare rating and one's feeling of discomfort remains undetermined; all that's known in either case is that when the glare rating is increased, the situation is less comfortable. We have no way of knowing when we are just "twice as uncomfortable."

Finally, the reader should keep in mind that this entire discussion and the papers referred to deal only with direct discomfort glare. Discomfort from reflected glare is still another problem.

The writer wishes to acknowledge his indebtedness to Mr. Phelps Meaker for his co-operation in connection with the preparation of this article.

# Stage Lighting Control

**The following is a description of the electronic system of stage lighting control which operates on remote control principles.**

Stage lighting has made great strides in recent years, and on the technical side there have been a number of developments which have resulted in a wider range of equipment and apparatus being made available to the theatre. Improvements in manufacturing processes, more efficient optical systems and advances in electric lamp design, to mention a few. These have resulted in an increased demand for capacity and flexibility in the gear controlling the stage lighting. Mere multiplication of electrical circuits, with their switches and so on, has not been the answer, as space in the theatre has always been at a premium and the increased physical size of the switchboard has tended to create operational difficulties.

It is believed that the answer has been found in the Strand Electronic Remote Control. Other types of remote control have, of course, been in use in this country and abroad for a number of years, but while they have done much to reduce noise and wastage of stage space they have not all given a single operator that instantaneous finger tip control which is an outstanding feature of the present system. In England they have relied, in the main, upon electric motors and a multiplicity of electro magnetic clutches, and on the Continent upon control wires and rods, to impart movement to the remotely operated dimmers controlling the intensity of the stage lighting circuits. In the Strand Electronic system there are no mechanical links between the control point and the remote apparatus. There is, in fact, only one moving part for each lighting circuit, and only one electrical connection (comparable in size with a bell wire) between the control desk and the "dimmer bank." The desk controls for each circuit consist simply of a single switch and miniature dimmer (potentiometer) handle. By appropriate setting of the switches as many circuits as desired can be controlled simultaneously, either for instantaneous switching on or off, or for dimming or brightening singly or in groups. The very

The electronic type switchboard as installed at the New Theatre, London.

great saving of space has made possible the duplication of the control panel, so that while one half is in use the lighting for the subsequent scene may be set up in advance on the other half and brought into use at any desired time or speed by the operation of a single handle. There are no technical limits to the size of such a switchboard, nor, within theatrical requirements, to the size of the electrical load handled by any one circuit. The same apparatus will, without any alteration or adjustment, control a battery of 1,000-watt spotlights or a single 15-watt bulb in a wall candle bracket.

This switchboard can, therefore, be constructed to suit any size of theatre regardless of the number or size of the stage lighting loads. It is silent in operation and, as the remote valve bank can be placed at any desired position in the theatre, it saves valuable stage space. The dimensions of the control desk are such that it can be placed in a position where the operator has an interrupted view of the stage while giving him a control of such completeness and flexibility as he has only dreamed hitherto.

The installation at the New Theatre, London, supersedes a direct manually operated board which had a handling capacity of only 40 circuits. In considering a new control system, it was thought that an additional hundred stage lighting circuits should be included, and that the control panel should be in a position to enable the electrician to see the stage. A direct hand-operated board for 140 circuits would have been almost 18 ft. long with a front working area of 146 sq. ft. The desk at the New Theatre, which is illustrated, actually controls 288 stage lighting circuits as each circuit has been duplicated. Ignoring the duplicate set for purposes of comparison of size, the electronic desk has a length of only 2 ft. 8 in. and a working area of only 8.6 sq. ft. The duplicate circuit enables the electrician to set up the next scene whilst one is in progress.

This system of control was invented by a member of the staff of the Strand Electric and Engineering Co., Ltd. The first installation was at the National Theatre of Iceland; by May next year a further eight installations will have been completed in this country, including the Old Vic and the Shakespeare Memorial Theatre at Stratford-on-Avon.

# How Hot is a Watt?*

**A study of light sources and lighting materials shows that the temperature of fittings is not always what one might expect.**

By J. G. HOLMES,
A.R.C.S., B.Sc., D.I.C., F.I.E.S.

Any schoolboy should know that a watt represents the same rate of flow of energy, whether it is electrical current, heat radiation, luminous flux or any other form of energy, and therefore that the resulting heating effect of a lamp—incandescent, discharge or fluorescent—should depend only on its actual wattage. A lamp with higher luminous efficiency will emit more of its energy as light, that is within the range of visible wavelengths in the spectrum, and we may be encouraged by the fact that a lamp of the maximum theoretical efficiency would give about 300 lumens of white light per watt. Our actual lamps, however, give only a small fraction of this theoretical maximum, and as even this light all degenerates eventually to heat when it is absorbed, our dream of "cold light" is very far from reality.

It is interesting that lighting designers have generally used the improvements in luminous efficiency given by gas and vapour discharge lamps and by fluorescent lamps to provide increased illumination rather than to reduce the power consumption, and as a result the heating effect of present-day lighting installations is not less, but often more, than in the past.

As soon as one starts to measure these things one finds an interesting anomaly. One would expect that the temperature of an efficient lighting fitting would be reduced by the use of a discharge lamp which has a higher luminous efficiency than an incandescent lamp of the same wattage, and which emits a greater proportion of its energy in the visible part of the spectrum and therefore relatively less in the infra-red or heating part of the spectrum. Glass and transparent plastics readily transmit light and are generally regarded as absorbers of heat radiation, so the more efficient lamp ought to give a cooler fitting. In practice, however, the high-efficiency mercury discharge lamps give much higher fitting temperatures than incandescent filament lamps of the same size and wattage. The same effect is found, in less degree, with open vitreous enamelled reflectors. It seems at first sight that a "mercury watt" is hotter than a "tungsten watt," and the purpose of this note is to give some data in explanation of this paradox.

We must accept as a scientific axiom the fact that the total rate of heat generation in any electric lamp is dependent only on the total wattage dissipated in the lamp. This total energy may, however, be emitted in different ways, and therefore may affect the temperature of fittings differently. The energy from the lamp appears partly in the form of heat conducted and convected from the hot glass bulb and partly in the form of radiation. This radiation comprises ultra-violet radiation, luminous or visible radiation and infra-red radiation, and we may become conscious of it in different ways, but when it is absorbed it all appears in the form of heat. The heating effect of the ultra-violet may be neglected, because it only represents about one per cent. of the total energy. The heating effect of the luminous radiation, in the visible region of the spectrum, varies from about 8 per cent. of the total for tungsten filament lamps to about 20 per cent. for fluorescent lamps. The infra-red radiation, which is commonly called "heat radiation" because we are only conscious of it in the form of heat, is subject to the same sort of laws of transmission, reflexion and absorption, and of concentration and diffusion, as the visible radiation. It is convenient, although not strictly correct, to use the term "radiant heat" for the total radiated energy from the lamp, but we must remember that this

* For those who really want to know, one watt is equivalent to 0.239 calories per second, or 3.41 British thermal units per hour.

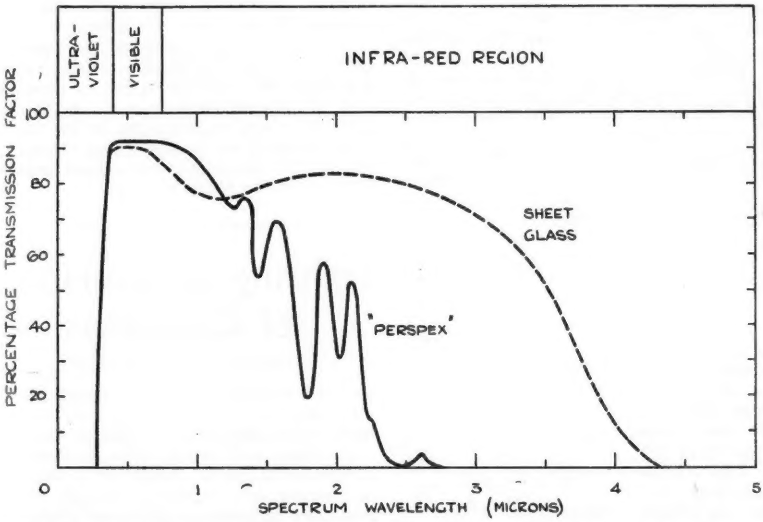
"radiant heat" will only raise the temperature of an object if it is absorbed by the object, and not if it is reflected or transmitted. Radiant heat includes a wide range of spectrum wavelengths, some of which may be absorbed more strongly than others. The heating effect of a lamp in a fitting thus depends partly on the proportion of conducted and convected heat relative to the radiant heat from the lamp and partly on the distribution of energy radiated at different wavelengths in the visible and, more important, in the infra-red region of the spectrum.

The energy distribution in the radiation from an incandescent filament follows the well-known Planck's law fairly closely, and the maximum is in the near infra-red region at a wavelength of about 1.1 microns. The energy distribution in the radiation from a discharge lamp is considerably different, being made of two parts, namely the radiation from the actual discharge and the radiation from the hot glass or quartz tube containing the discharge, and the maximum is at a longer wavelength, about 2 microns, in the long-wave infra-red region of the spectrum. It so happens that glass is almost as transparent to the near infra-red as it is to light, and therefore the radiant heat from a filament lamp may be controlled or diffused without much loss due to absorption in the same way as the light from the same lamp.

Glass is, however, almost opaque to the far infra-red, and any radiation in this region of the spectrum is absorbed, rather than transmitted or reflected, as shown in the diagram. It follows that the glass bulb of a mercury discharge lamp gets hotter than the glass bulb of a filament lamp of the same size and wattage and that the air around the mercury lamp will therefore get hotter. This gives us our first reason for finding that a fitting with a mercury lamp runs hotter than with a corresponding filament lamp.

When the radiant heat from a mercury discharge lamp falls on a glass reflector or diffuser, it will be absorbed to a greater degree than the radiant heat from a filament lamp and, again, the complete lighting fitting will tend to reach a higher temperature with a mercury lamp than with a filament lamp of the same wattage.

We have already noted that the radiant heat from a filament lamp, which is not strongly absorbed by the fitting, is concentrated or diffused by the fitting in the same sort of way as the light from the lamp, and it may reach the working plane to a greater extent than the radiant heat from a mercury discharge lamp. There is therefore a real




**Relation between transmission factor and spectrum wavelength for radiant energy passing through ⅛-in. (24 oz.) sheet glass and ⅛-in. "Perspex."**

significance in the words "cool light" when applied to discharge lamps because the fitting tends to filter out the far infra-red radiation from these lamps and to dissipate this heat in the air above the fitting rather than to direct it on to the working plane. The words "warm light" applied to low-efficiency filament lamps have no physical significance because the radiant heat from these lamps is more strongly absorbed in the fitting than that from high-efficiency filament lamps; the radiation from a vacuum lamp may, however, seem "warm" because the energy losses in convection and conduction are reduced.

Enclosed lighting fittings show the temperature difference to a greater extent than open reflector fittings because the whole of the radiation has to pass through the glass, whereas in an open fitting a part of the radiant heat is emitted direct through the aperture and does not affect the temperature of the fitting itself. The figures given in the table indicate the relative temperature rise in degrees per watt which may be expected in enclosed and open fittings, taking an incandescent filament lamp (General Lighting Service) as unity.

| Type of Lamp | Relative temperature rise in Enclosed Glass Fittings | Relative temperature rise in Open Glass Reflector Fittings |
|---|---|---|
| Incandescent Filament (G.L.S.) | 1.00 | 1.00 |
| 160w, 200w & 250w Blended, Type MBT | 1.25 | 1.15 |
| 300w & 500w Blended, Type MAT | 1.40 | 1.20 |
| 80w & 125w Mercury, Type MB | 1.55 | 1.30 |
| 250w & 400w Mercury, Type MA | 1.65 | 1.35 |

From these figures we may say that a 200w MBT/V blended lamp would probably give 15 per cent. greater temperature rise in an open fitting or 25 per cent. greater temperature rise in an enclosed fitting than a 200w filament lamp. Alternatively, a 160w MBT/U blended lamp or a 125w MB/V mercury lamp would give much the same temperature rise in an enclosed fitting as a 200w filament lamp. For the type MA/V mercury discharge lamps, the 250w and the 400w lamps would give much higher temperatures than the 300w and 500w filament lamps respectively.

Although the figures in the table have been taken from measurements on prismatic glass fittings, the same general considerations apply to vitreous enamel reflectors and to translucent plastics because these materials also show a much greater absorption factor for the long-wave infra-red radiation from mercury discharge lamps than for the near infra-red radiation from filament lamps. Typical data for ⅛-in. "Perspex" are shown in the diagram.

It has not been possible to make a direct comparison between the heating effects of fluorescent or sodium discharge lamps and of filament lamps because of the great differences in size and shape, but from general considerations it may be stated that these highly efficient lamps give much higher fitting temperatures than would be given by filament lamps of the same size and wattage, if they were available.

There can be no answer to the rhetorical question in the title of this article, because a watt has no temperature, but we have seen that the heating effect of the wattage dissipated in a lamp is dependent on the type of lamp and also on the absorption characteristics of the apparently transparent material with which the fitting is made.

# Lighting in the House of Commons

(*Continued from page* 436)

special channel fittings designed for attachment to concrete joists, or by tungsten lamps in trough reflectors. Special industrial type ceiling and trough reflector fittings are used in plant rooms. Some are arranged to incorporate the tungsten lamps of the secondary lighting system, and others are designed for mounting end to end in a "U" formation. Telephone kiosks throughout the building are lighted by 40w. tungsten lamps in combined air vent and lighting fittings, made by Falk, Stadelmann and Co., Ltd.

The electrical contractors were Messrs. Troughton and Young, Ltd. The new building includes the main Chamber, the Division and Entrance Lobbies adjoining the Chamber, and the Conference Rooms, offices, lounges, etc., on the other three floors of the new building. By arrangement with the architect and the consulting engineers, and in order to hasten completion of the work within the time required, part of the lighting of the precincts outside the Chamber was executed in co-operation with Messrs. Osler and Faraday, Ltd., Smith and Ansell, Ltd., and Benjamin Electric, Ltd.

# The Lighting of Exhibition Buildings*

**Some notes for designers discussing factors in illumination for display. The distribution of brightness, glare, stimulation, and the reduction of reflections are shown to be the main points to be watched, and guidance on each is given.**

By JOHN BICKERDIKE, A.R.I.B.A.

These notes were originally prepared at the Building Research Station to guide designers working on the Festival of Britain, some of whom had consulted the Station. It seemed possible they might be of interest to lighting engineers generally, and for that reason they are published here.

### Balance of Brightness

Good vision is possible only when the eyes can adapt properly to the brightness in the field of view. Thus, when the surroundings to a display are brighter (i.e., lighter in colour or better illuminated) than the display itself, our eyes adapt to the surround and the display looks dimly lighted. Similarly, if the transition from a bright zone to a darker zone is sharp, we cannot see things in the darker area for some moments until the eyes have had time to adjust themselves. This last situation is at its worst, for example, on entering a building during daytime when the entrance area is insufficiently lit. Similarly, at night when a view out on to the night scene is desired, the interior at the observation point must be weakly lit and the fittings well out of sight. When the view is through a window, the surfaces opposite to the window and behind the viewer should always be dark, otherwise their reflections will prevent outward views. Do not floodlight the observation points from the outside at night. Nothing outside will be visible except the floodlight.

The object on view should usually be brighter than its surroundings. It is then certain to attract attention. A dark coloured surface will need proportionally more illumination than a similarly placed surface, lighter coloured, to achieve the same effect.

### Glare

Remember that glare is the result of excessive brightness contrast and not of brightness alone. Familiar examples of glare are an exposed light fitting seen against a relatively dark background, a window with dark surrounds and dark glazing bars, or displays which are too brightly lit on a dark background, or conversely a dark exhibit against an excessively light background.

As a general rule, the source of light should be out of view or screened by louvres. This avoids glare and distraction. If this cannot be done, the surface brightness of the fitting must be reduced by a translucent cover.

### Stimulation

Mild glare, or sparkle, is stimulating and can make all the difference in the interest a display arouses. A large area source, like a window or a fluorescent tube is too diffuse to give sufficient contrast or high-light for this. Point sources give greater contrast and sharp high-lights. A good rule is not to use fluorescent light without some tungsten spotlighting for interest and sparkle and for capturing attention. Also, colour distortion in the displays is reduced by mixing; the deficiency of red in fluorescent light is compensated by the tungsten source.

Similarly some variation of illumination levels from one display area to another may be desirable to maintain interest and sensitivity. But the transition from a very well lit area to a much darker one should always be done gradually; that is, a short run of intermediate brightness should be interposed.

### Reflections

Wherever possible, exhibits and showcases should be unglazed. The problems of reflection in glass here are identical with those in picture gallery lighting. Briefly, any object or person in the reflected line of view which is brighter than the things on

* Published by permission of the Director of Building Research, Garston.

show behind the glass will be mirrored in the glass.

The greater the brightness contrasts are, the more obvious and disrupting are the reflections. Dark backgrounds in show cases —as in shop windows—should generally be avoided and many reflections will be prevented if the illumination in the show cases is considerably higher than elsewhere in the room. This, of course, fits in with the value of lighting the exhibit preferentially.

In the lighting of display panels and murals it has to be borne in mind that specular (mirror-like) reflections occur even off a mat surface. This means that flat panels cannot be lit well by sources subtending a low angle to their surface. As the angle gets flatter more and more light will be specularly reflected off the panel which will get progressively less bright. In addition, disruptive high-lights can occur more easily under this conditon. Rule: always try to get the source of light subtending a high angle to the surface. Glossy surfaces are, of course, more difficult to light uniformly without specular reflections.

# Some Interesting Phenomena in Colour Vision

At the meeting of the Colour Group on October 4, two papers were read on quite different problems of colour vision, although in both cases the effect of the size of the retinal area stimulated was a dominant factor. Messrs. R. G. Horner and E. T. Purslow, of Ilford Ltd., discussed the influence of field size on the colour match obtained in an anomaloscope. Anyone with even an elementary knowledge of the facts of colour mixture is aware that when red and green lights are mixed in suitable proportions, the sensation produced in the eye is that of yellow and, in fact, it is quite easy to match an unsaturated yellow with such a mixture by altering the relative proportions of the components. This, however, is not the whole story for the proportions depend quite noticeably on the size of the field of view if the various colours are approximately monochromatic. In other words, the ratio of narrow-band red to narrow-band green required to give a mixture which matches a narrow-band yellow depends on the field size. Members of the audience were able to verify this statement for themselves, and it was very interesting to see how an excellent match made under small-field conditions would look quite wrong when a mask was removed so as to expose a much larger area of the matching field. The authors discussed possible explanations of the effect but pointed out that the known peculiarities of central foveal vision were inadequate to provide a complete explanation since the effect was not limited to small fields.

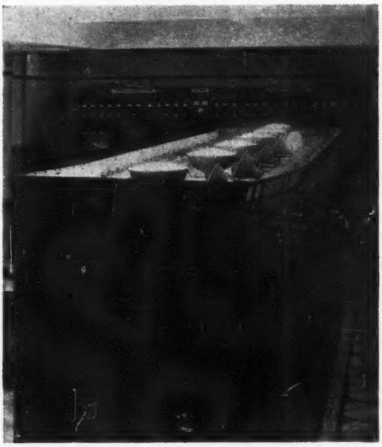
The other paper presented on this occasion was read by Dr. E. N. Willmer of the Cambridge Physiological Laboratory and was entitled "Some aspects of colour adaptation in the central fovea." Dr. Willmer has carried out a great deal of work on the properties of the tiny area of the retina at the very centre of the fovea, the area on which the eye normally focuses the centre of the object of attention, and in particular he and others have studied the colour sensitivity of this area and have found that it differs in certain respects from the colour sensitivity of the fovea as a whole. In the case of the "normal" eye, when this area is adapted to lights of different wave-lengths its thresholds for red and for violet light are raised to different extents and a definite "pattern" of response is obtained depending on the intensity and wave-length of the adapting light and on the wave-length of the test light. When a similar experiment is carried out with subjects having a certain type of defective colour vision, however, the results are not the same. Dr. Willmer described what took place in the case of subjects in which the luminosity curve (for foveal vision) was displaced towards the red end of the spectrum. In these cases the amount of adaptation appeared to be independent both of the wave-length of the adapting light and of that of the test light, in fact it depended only on the subjective brightness of the adapting light. It is not at all easy to account for this result but Dr. Willmer attempted to provide a possible explanation which was later discussed at some length by those present.

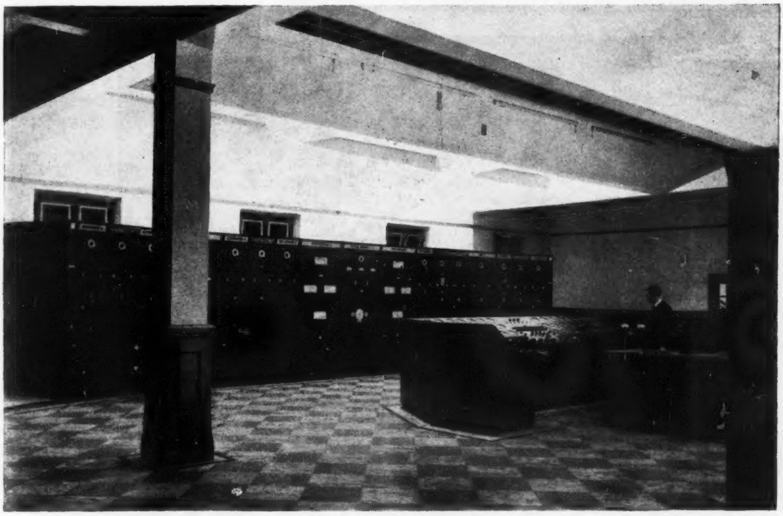
# New Lighting Installations

### Lighting in a Generating Station

The lighting of the Control Room of the Walsall Generating Station is designed on unusual lines. It was decided that tungsten lighting in preference to fluorescent lighting should be used in view of its greater reliability under low voltage conditions, and the facility for placing part of the installation on the emergency changeover circuit. At the same time it was decided that no lighting fittings pendant from the ceiling, or otherwise, were to be visible.

Fortunately, it was possible to undertake the lighting design work at a sufficiently early stage to enable arrangements to be made with the control panel manufacturers to provide a continuous recess in the top horizontal plates of the panels to enable lighting reflectors to be installed therein and entirely screened from view. Totally indirect lighting was utilised, provided by Benjamin Standard R.L.M. "Crysteel"





*(Above)* Showing the effect of the concealed lighting in the control room of the Walsall Generating Station. *(Top right)* A close-up view of the top of the main panel where the lighting is concealed.

vitreous enamel reflectors of the highest efficiency with dustproof covers to prevent ingress of dirt.

This provided the main illumination, which was graduated so that the brightness of those parts of the room unoccupied by panels was reduced, thus affording some relief to the eyes from the higher brightness of the panels. The ceiling beams provided a certain shadow component, so avoiding the monotony which would have otherwise resulted from a ceiling of uniform brightness.

The centre part of the ceiling of this control room is broken by the large lantern for the admission of daylight. This area of the ceiling is dark at night and from the normal viewing position underneath this lantern, this dark area of ceiling is imaged in the instrument dials, thus providing a maximum comfortable visibility.

To boost the brightness of the ceiling in front of the panels, a series of "Projectolux" units were installed as shown in the close-up photograph. For the illumination of the panels at the far end of each side, "Anglite" corner troughs were concealed behind the beam.

The lighting installation was planned by the Benjamin Electric, Ltd., in conjunction with the Chief Generation Engineer (Construction), Midlands Division, British Electricity Authority, and installed by France's Electric, Ltd.

**Works Theatre and Restaurant**

The new W. D. and H. O. Wills Cigarette Factory at Newcastle-upon-Tyne has many amenities provided for the welfare of the work-people, and a typical example is the new Theatre/Restaurant. As a restaurant it seats 500; the room can be arranged as a theatre or dance hall for social occasions. A fully equipped stage is provided with all that is necessary for ambitious theatrical productions, and the lighting of the building, as a whole, had to be suitably designed for a wide variety of functions.

A centre laylight, together with ample side windows, provides excellent lighting during day-time whilst at night a particularly pleasing system of Holophane "In-Bilt" controlens units provides a soft uniform illumination. In the barrel ceiling semi-recessed fittings are employed with dished controlens plates projecting about 3 in. from the ceiling, so as to throw sufficient light upwards to give a uniform but not excessively bright ceiling. Two-light and three-light units, in pairs, alternately placed in two rows down either side give added interest to the lighting system, which harmonises well with the architecture of the hall.

Supplementary lighting is included above the lay-light, so that this does not appear dark at night time, and here industrial fittings have been employed, mounted at the

The Theatre-Restaurant at the new cigarette factory at Newcastle-upon-Tyne.

*(Right).* The machine room of Peek Frean's biscuit factory, showing the 5-ft. angle reflectors with "Perspex" transparent covers.

*(Below).* A view of the conveyors showing the low mounted continuous troughing.

sides, so that the reflectors are not seen in silhouette during the day.

In the side and end sections, where the concrete construction of the roof did not permit a recessment of the fittings, Holophane Close Ceiling Controlens Units have been mounted between the main beams which support the roof.

The lighting installation was planned by Holophane, Ltd., and the installation work was carried out by Messrs. W. J. Furse and Co., Ltd., of London, who also supplied the stage colour lighting equipment.

### Biscuit Factory

A new lighting installation planned by Metrovick Illuminating Engineers has recently been installed at the biscuit factory of Messrs. Peek Frean and Company, Ltd., London.

In the lighting of any factory engaged in the preparation of foodstuffs it is important to ensure that the lighting equipment is of first-class quality. There must be no possibility of flaking paint or enamel dropping on to the foodstuff in preparation. At the same time fittings least liable to infestation should be used, and for these reasons 148 Metrovick "Perspex" 5 ft. fluorescent trough fittings were selected by Mr. G. W. Davies, the chief engineer of the factory. These, with additional 5 ft. angle units along the walls, form the general lighting.

Three conveyors are used and lighted by 5 ft. fluorescent lamps in continuous troughs designed for easy maintenance and fitted with "Perspex" transparent covers to prevent any possible risk of glass, etc., falling on to the biscuits.

These troughs are especially shallow to enable the operators' hands to work between the unit and the conveyor, and as the units are below the eye-level, the operatives work under adequate and comfortable seeing conditions.

In the machine room, where the dough is laid and the biscuits punched and formed before going into the ovens, it was stipulated that the exposed parts of the machines as well as the unbaked biscuits should be evenly illuminated. The rooms are narrow and the machines high, but entirely satisfactory results have been obtained by using 57 5-ft. fluorescent lamps in angle reflectors with "Perspex" curved transparent covers.

### Lighting in a Bank

The illustration, left, shows the new lighting installation at the Chartered Bank of India, Australia and China, 38, Bishopsgate, E.C.

This fine and extensive banking hall is illuminated by means of nine Atlas specially designed lighting fittings No. E.49/5, each of which accommodates eight 40-watt 4-ft. fluorescent tubes and six 30-watt fluorescent tubes, "Warmwhite" in colour. The resulting illumination enables local lighting to be dispensed with whilst giving a low brightness fitting of large light output.

The fittings were designed and supplied by the Lighting Division of Messrs. Thorn Electrical Industries, Ltd., and the contractors were Messrs. Bell Bros. (London), Ltd.

# I.E.S. ACTIVITIES

## Regional Chairmen—Session 1950-51

**Bath and Bristol.**

Mr. H. J. Weston has been on the staff of the Street Lighting Department of Bristol since 1933. In addition to the installation and maintenance of street lighting within the city he is also responsible for traffic signals and signs and floodlighting and other special decorative lighting schemes arranged by the civic authorities.

**Birmingham.**

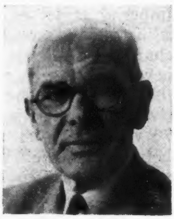
Mr. F. Penson was for fourteen years with Furse and Co. Ltd., and is now with Walker Bros. (Electrical Engineers) Ltd., as manager of their contracts and installation department. He has been responsible for many large interior lighting installations in Birmingham.

**Bradford.**

Mr. H. G. Collinson is a director of Collinson Bros. Ltd., the electrical contractors of Bradford. He formerly lectured in electrical installation work at the Bradford Technical College. During the war he served in the mine sweeping branch of the Royal Navy.

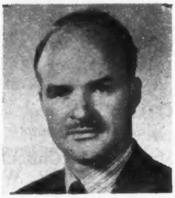
**Cardiff.**

Mr. D. C. James, F.I.E.S., has been in illuminating engineering since 1919 and is with the G.E.C. He has been a very active lecturer for the Society and has given many lectures to school children and to students taking the City and Guilds examinations.



**Huddersfield.**

Mr. H. Walton, M.SC. (Eng.), A.M.I.E.E. has been with David Brown and Sons (Huddersfield) Ltd., since 1938. He is primarily concerned with works engineering and has been Assistant Chief Works Engineer since 1947. He is also on the Register of Lighting Engineers.



**Glasgow.**

Mr. F. Dunnet is Joint Managing Director of Holland House Electrical Co. Ltd., whom he joined in 1933. He has had experience in both electrical and mechanical engineering, and during the war he served in the mine sweeping branch of the Royal Navy.

**Gloucester and Cheltenham.**

Mr. I. R. Morgan is the Gloucester manager of the G.E.C. which he joined in 1915. He is a founder member of the Centre and is keen to interest the younger members of the industry in the Society. He is also interested in the educational work of the Society.

**Leeds.**

Mr. J. W. Howell, D.L.C., M.I.E.E., F.I.E.S., has been a leading member of the I.E.S. in Yorkshire since he helped to form the Leeds Centre in 1937. After serving with the G.E.C. at Witton for ten years he joined the L.S.B. in London in 1933 and is now responsible for L.S.B. activities in the north.

**Liverpool.**
Mr. T. D. Woods is a director of Messrs. Downes and Davies Ltd. He entered the firm in 1936, returning to them in 1946, after six years in the Army. He was appointed to the board in 1947. He is keenly interested in lighting matters.

**Nottingham.**
Mr. G. C. Small entered the electricity supply industry in 1925 and in 1935 became responsible for all exterior lighting under the former Midesco group of companies. He is now section head in charge of street lighting for the East Midlands Elec. Board.

**Manchester.**
Mr. W. G. Chilvers, A.M.I.E.E., F.I.E.S., is a section head on installation on the Chief Commercial Officer's staff of the N.W. Elec. Board. Formerly with the Cardiff Corp. Elec. Dept., after which he was Area Officer of the Br. E.D.A. in the North-west.

**Sheffield.**
Mr. J. A. Whittaker, A.M.I.E.E., F.I.E.S., has been closely associated with the Centre since its inception. He joined the G.E.C. in 1933 and for some years has been responsible for the lighting department of their Sheffield Branch.

**Newcastle.**
Mr. J. S. McCulloch is a partner of R. W. Gregory and Partners, Consulting Engineers, whom he joined in 1936. He began his career with Merz and McLellan in 1925. He has had a wide experience in lighting in shipyards in addition to industrial and other interiors.

**Sussex.**
Mr. H. S. Barlow, MS.C., F.I.E.S., was formerly on the staff of the College of Technology, Manchester. He was responsible for the original courses in lighting at the Northampton Polytechnic, London. He is now head of the Physics and Maths. Depts. of the S.E. Essex Technical College.

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# Recent Meetings

### London

At the sessional meeting held in London on November 14 a paper on the lighting of the new House of Commons was presented by Mr. C. Dykes Brown. Although the House of Commons has been erected on the original site many improvements have been made in the new building. Amongst these the lighting, especially in the Debating Chamber, is of particular interest. The main lighting is provided by cold-cathode units above a laylight; there is supplementary lighting under the gallery and indirect lighting from the window sills helps to lighten the ceiling. (As the lighting in the House is fully described in an article elsewhere in this issue the detail of Mr. C. D. Brown's paper is not given here. The paper will appear in the I.E.S. Transactions in due course.)

### Birmingham Centre

The first meeting of the 1950-51 session of the Birmingham Centre was held at the Imperial Hotel on Friday, October 6. As is usual, this meeting was devoted to the chairman's address. Mr. Frank Penson, the new chairman, is a well-known member of the E.C.A., and he gave a very comprehensive outline of wiring systems over the past 70 years.

In the earlier stages bare copper wire supported on procelain insulators was used to convey the current to the service points. The next development was the vulcanised

rubber cable which was often enclosed in wooden casing. The V.I.R. cable eventually progressed to a protective sheath of tough rubber or lead alloy.

Mr. Penson said the introduction in 1898 of light close joint steel tubing with push-fit malleable iron fittings laid the foundations for the present widely used steel conduit system with its complete continuity. It gives almost complete protection from mechanical damage and fire risks when installed by skilled operatives. A recent innovation was the introduction of aluminium alloy conduit with die cast alloy accessories. Here Mr. Penson gave a warning about the suspension of heavy lighting fittings when using this system.

Other wiring systems, each having their different merits, include paper insulated and armoured cables, overhead bus bar systems, copper and fibre conduit systems, and, the most recent, the mineral insulated copper conductor system.

Mr. Penson went on to describe duct and trunking systems, which, he said, were used for housing lighting, power and telephone lines and plumbing, and gave a much needed tidy appearance to building interiors.

He concluded his address with a description of the mineral insulated copper-covered cables which, although made in comparatively short lengths, had several advantages for particular uses.

Mr. Cocksedge, who proposed vote of thanks, complimented the speaker on the wide range of his paper, and the vote was seconded by Mr. Redmond.

### Manchester Centre

A party of 34 members of the Manchester Centre visited the lamp works of Siemens Electric Lamps and Supplies at Preston on October 19. The tour of the works included every stage in the manufacture of tungsten lamps, including testing.

Members were particularly impressed by the up-to-date methods employed in the factory, recently built for the manufacture of fluorescent lamps.

Refreshments were provided and the chairman of the Centre, Mr. W. G. Chilvers, thanked Mr. P. D. Oakley and his assistants for making the visit one of the outstanding events of the year for the Manchester Centre.

# Forthcoming I.E.S. Meetings

## LONDON

**1950**

**December 12th**
"The Development of the Tungsten Lamp," by B. P. Dudding. (At the Lighting Service Bureau, 2, Savoy Hill, W.C.2.) 6 p.m.

**1951**

**January 9th**
Sessional Meeting. "Brightness Engineering," by W. Robinson. (At the Lighting Service Bureau, 2, Savoy Hill, W.C.2.) 6 p.m.

**January 17th**
First Trotter-Paterson Memorial Lecture. "The Early Years of Illuminating Engineering in Great Britain," by J. W. T. Walsh. (At the Royal Institution, Albemarle Street, W.1.) 6 p.m.

## CENTRES AND GROUPS

**1950**

**December 4th**
"Light and the Eye," by Dr. W. J. Wellwood-Ferguson. (Joint Meeting with the Yorkshire Optical Society.) (At the Lighting Service Bureau, 24, Aire Street, Leeds, 1.) 7 p.m.

**December 4th**
"Specialized and General Lighting in Hospitals," by M. W. Peirce and D. J. Reed. (At the Lecture Theatre, Merseyside and North Wales Electricity Board's Service Centre, Whitechapel, Liverpool, 1.) 6 p.m.

**December 4th**
"Control Gear for Fluorescent Lamps," by S. Anderson, (At the Medical Library, The University, Weston Bank, Sheffield, 10.) 6 p.m.

**December 6th**
"Notes on Industrial Lighting," by W. Imrie-Smith. (At the Minor Durrant Hall, Oxford Street, Newcastle-on-Tyne, 1.) 6.15 p.m.

**December 6th**
"Stage Lighting," by E. Faraday. (At 4, Northampton Gardens, Swansea.) 5.45 p.m.

**1950**

**December 8th**
"Stage Lighting," by E. Faraday. (At the South Wales Electricity Board, Demonstration Theatre, The Hayes, Cardiff.) 5.45 p.m.

**December 12th**
Brains Trust. (At the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2.) 6 p.m.

**December 12th**
"Lighting of Architecture," by G. Grenfell Baines. (At 31, Kingsway, Stoke-on-Trent.) 6 p.m.

**December 13th.**
"Lighting for Celebrations," by C. J. King. (At the Welfare Club Hall of the City of Edinburgh Lighting and Cleansing Department, High Street, Edinburgh.) 7 p.m.

**December 14th**
"Sports Lighting," by D. E. Beard. (At the Cadena Cafe, Eastgate Street, Gloucester.) 6.30 p.m.

**December 14th**
"The Electronic Flash Tube," by A. J. Meadowcroft. (At the Demonstration Theatre, East Midlands Electricity Board, Leicester Sub-Area, Charles Street, Leicester.) 6.30 p.m.

**December 14th**
Luncheon Meeting. (At the Midland Hotel, Manchester.) 12.30 p.m.

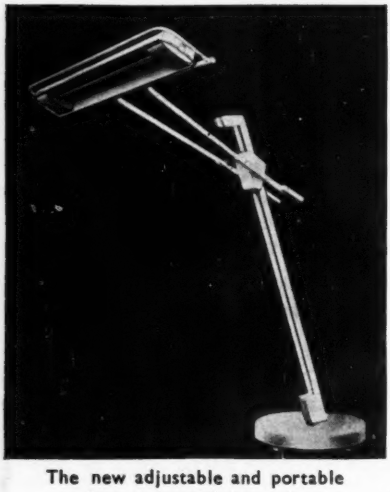
**December 14th**
Presidential Address by L. J. Davies. (At the Demonstration Theatre, Manchester Town Hall Extension.) 6 p.m.

**December 20th**
"Acrylic Plastics in Lighting," by P. Collins. (At the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.)

**December 28th**
Brains Trust. (At the Gas Showrooms, Parliament Street, Nottingham.) 5.30 p.m.

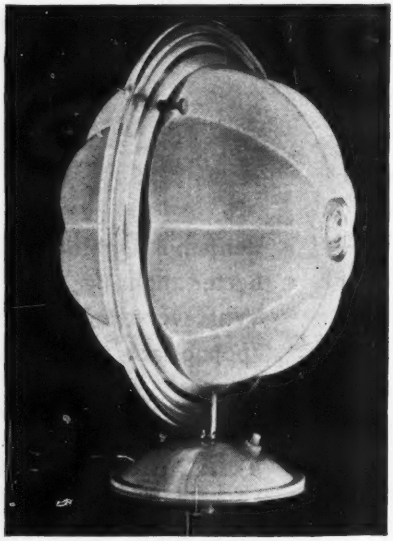
# Lighting Fittings

THE LEIGH ELECTRIC CO. LTD. announce a new range of large, portable and adjustable fluorescent lighting units applicable to many lighting problems in industry. The larger models have particular application in the aircraft industry, and in bus and coach works, where high roof lighting does not give sufficient light intensity in the floor zone, and where the whole bulk of the aircraft fuselage or wing assembly, or the coach body, cannot be adequately lit by any roof lighting. Smaller models have appeal in the servicing and repair of motor-cars and bodies, where adequate light can be provided all round the vehicle—even upwards when the vehicle is on a lift. Either twin 2-ft. or single or twin 5-ft. fluorescent lighting troughs, according to model, are mounted on the outer end of a twin tubular boom. The inner end of the boom swivels on a trolley which travels on rails between the twin tubes of the inclined pillar. The boom assembly is balanced by weights running inside the pillar tubes. The whole assembly swivels on ball bearings at the base. Four heavy ball or roller-bearing castors are provided for easy running on industrial floors. The fluorescent gear is housed within the trolley, and is easily accessible on removing a cover. Heavy steel bases are provided to prevent tipping, and the light can be easily manipulated from the hand-rail around the lamp trough. The larger models have a maximum lamp height of 12 feet and a reach from the base edge of about four feet. Smaller models have a maximum height of six feet with a reach of about three feet.



The new adjustable and portable fluorescent lighting unit.

FALK, STADELMANN AND CO. LTD. have just introduced a new table lamp of unusual design as shown in the illustration. It would appear to have applications for lighting hotel and restaurant tables as well as for home lighting. The bowl is 12 inches high and accommodates a 60-w. lamp.



An unusual table lamp for use with a 60-watt lamp.

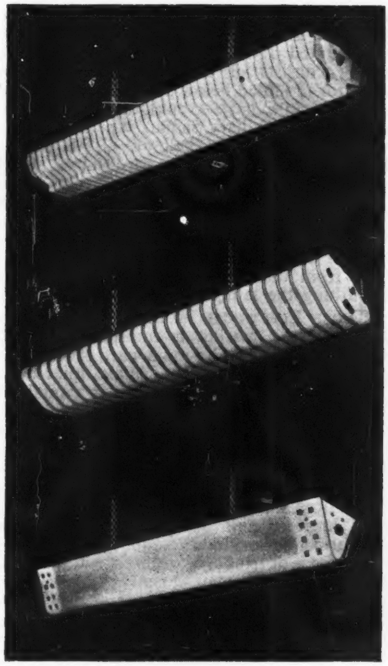
The latest addition to the range of fittings available from CROMPTON PARKINSON LTD., is the AR.2531, two 80-watt, 5-ft. tube fitting giving soft diffused lighting for high grade retail stores, offices, and commercial premises generally. Including gear, the price is only £20 7s. 2d. plus purchase tax

£3 9s. 5d. It is a totally enclosed design that completely excludes dust and insects from the interior and with an exterior surface that can be kept perfectly clean simply by wiping. Available for close ceiling mounting or suspension from chain or conduit. For easy access to the tubes and starters the diffuser is arranged with a two-way hinge action so that it can be swung down. For any servicing there is no need to dismantle or completely remove any part.

Another new fitting, the Type AE.2431, is available in different styles to meet particular requirements of appearance and lighting effect. One style has "Perspex" side and base panels available in alternative finishes: (1) Fluted crystalline for use where some sparkle or glitter is desirable. These panels have flashed opal ends to minimise the effects of "end-flicker"; (2) Plain opal for enhancing dignity and providing soft lighting effects. A louvred base is available as an alternative to a "Perspex" base.

Hitherto the largest mercury lamp in general use for lighting large areas in industrial premises has been the 400-watt size, and this has necessitated the use of a considerable number of light sources to provide satisfactory illumination on the working plane in spacious and lofty buildings. The General Electric Co., Ltd., has now developed a new 1-kw. mercury lamp to enable the lighting of such premises to be carried out efficiently with a smaller number of lamps and a consequent reduction in installation and maintenance costs. The economies in maintenance will be particularly advantageous in buildings where lamps have to be mounted at a great height so that access to them is a major undertaking.

The new G.E.C. 1-kw. mercury lamp for high bay lighting.



Some of the new range of decorative fittings recently announced by Siemens. All the fittings illustrated are for 3-ft. lamps.

The new lamp has an average efficiency through life of 45 lumens per watt, which is some 25 per cent. higher than the corresponding figure for the 400-watt lamp. Its average light output of 45,000 lumens is nearly twice as much as that of a standard 1,500-watt gas-filled tungsten lamp. The lamp has a bulb of the shape known as isothermal, and is fitted with a G.E.S. cap.

Having an arc voltage of approximately 300, the lamp requires a mains supply of the order of 400 volts, but this supply is normally available in all situations where the lamp is likely to be used, namely, in industrial premises with three-phase mains. Two standard 400-watt chokes connected in series will provide the necessary stabilisation on 420 volts and above. A tapped choke to cover the full range of voltages from 350 to 450 is in preparation.

A high bay reflector fitting specially

developed for the lamp is designed to give the best utilisation of light when the unit is mounted at a considerable height. The fitting consists of an anodised aluminium reflector mounted below a vitreous enamelled canopy with large ventilation slots, and carrying an auxiliary Saaflux-type aluminium reflector cone and skeleton G.E.S. lampholder. A clip-on ½-in. wire mesh guard is provided.

Some upward light is emitted through the ventilation slots, and deposition of dirt on the reflecting surfaces is retarded by the convection air stream. The reflector is detachable from the canopy for cleaning without disturbing the lamp.

THORN ELECTRICAL INDUSTRIES, LTD., now have on the market a translucent trough fluorescent fitting, the main part of which is press-moulded from a single piece of "Perspex." The control gear is contained in a tray fixed to the top of the reflector. The translucent nature of the fitting permits a considerable amount of upward light where this is desired.

A recent introduction of the STANDARD TELEPHONES AND CABLES, LIMITED, is their staff locating unit. This device works on the principle of light combinations. It is comprised of rings of transparent material mounted on a matt black cylinder with chromium plated fittings. It can be mounted either horizontally or vertically. When the contact key is operated the associated ring is illuminated with a distinctive coloured light. Control can be exercised from any desired point, although it is usually more convenient for the control unit to be located at the telephone exchange. This system, which operates form the electric mains, has 31 colour combinations, which means that 31 individuals can be paged, the lights being flashed instantaneously to all departments.

## Trade Literature

THORN ELECTRICAL INDUSTRIES, LTD. Brochure on "Atlas" fluorescent stage lighting.

BENJAMIN ELECTRIC, LTD. Loose-leaf catalogue of "Fluroliers" for fluorescent lighting.

BERRY'S ELECTRIC, LTD. Catalogue entitled "Lighting of To-day," showing wide range of decorative fittings, some in colour.

BRITISH ELECTRICAL DEV. ASSOC. Booklet entitled "Fluorescent Street Lighting," giving some interesting and useful details with many pictures of installations.

BRITISH THOMSON-HOUSTON CO., LTD. Lighting equipment catalogue, pocket edition. Also leaflets giving details of "Mazda" reflector fittings with performance data, polar curves, etc.

THE EDISON SWAN ELECTRIC CO., LTD. Detailed catalogue of commercial and decorative lighting fittings and equipment.

W. EDWARDS AND CO. (LONDON), LTD. "Digest" catalogue of high vacuum equipment for industry, research, and education.

THE GENERAL ELECTRIC CO., LTD. Catalogue (section F.1) of domestic and commercial lighting fittings other than fluorescent. Also price list of range of "Osram" lamps.

LINOLITE, LTD. Leaflets dealing with (i) decorative fittings and (ii) general purpose fittings for shop windows, showcases, sign and picture lighting.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD. The company's Jubilee Book, "1899-1949," produced to commemorate the golden jubilee of the company and reviewing the firm's activities since its beginning.

Catalogues of (i) lamps, (ii) commercial fittings, and (iii) a general catalogue dealing with the firm's principal products.

SIEMENS ELECTRIC LAMPS AND SUPPLIES, LTD. Catalogue and price list of "Sieray" fluorescent fittings and lighting equipment.

SIMPLEX ELECTRIC CO., LTD. Price list of conduit fittings.

VENNER TIME SWITCHES, LTD. Leaflet on double-circuit or double-pole time switch.

# POSTSCRIPT

## By "Lumeritas"

The speed of light, it seems, has recently been measured with greater precision than heretofore. According to a D.S.I.R. announcement, featured in the radio news and the daily Press, light is now known to travel at 186,282 miles per second, which is said to be a speed 11 miles a second faster than the previously accepted rate. Readers who have been well satisfied if they could remember the speed of light as "about 186,000 miles a second," but who have been prompted by the recent announcement to "look it up" in the "authorities," will find a variety of figures, some of which are greater instead of less than the new figure. The difference, however, is small between the new figure and any of those to be found in current works of reference, and we are not likely to be greatly surprised if yet another value for the speed of light is published ere long.

A Report has recently been made by a Ministry of Transport "working party" on ships' navigational aids, which includes recommendations for the lighting of ships' chart-rooms. It is important that at night-time the dark adaptation of ships' navigators should not be seriously impaired—even temporarily—by exposure of the eyes while in the chart-room to light of unsuitable brightness and colour. Dark adaptation is least disturbed by red light, to which, however, there are certain objections. It is therefore recommended that ships' chart-rooms should be provided with orange lighting. To facilitate the reading of corrections to Admiralty charts, light lists, and other publications illuminated by orange light, these corrections are made in violet ink.

During his recent Presidential Address to the I.E.S., Mr. L. J. Davies gave a demonstration that was amusing and well calculated to mystify any audience not versed in the science of vision. He showed a five-foot fluorescent tube arranged so that light was emitted only by the incandescent electrodes. While, therefore, the tube appeared bright at its extremities, it was much less bright over the intervening major part of its length. On being moved up and down fairly rapidly (in the darkened room) or given an oscillatory motion about its mid-point, the extremities of the tube appeared to flap about as if the tube were made of flexible material. This novel demonstration "works" because the time required for the development of visual perceptions depends on the strength of the visual stimulus. Thus, by the time the dim portion of the tube is perceived at one position in the visual field perceptions have developed of the brighter parts in the new positions to which these parts have been moved. As there is a brightness gradient from the ends of the tube towards the centre, there is a corresponding gradient of the rate of perceiving the position of different parts of the moving tube, so that the brighter the part the more advanced its position appears to be in relation to that of the dimmest part and the tube looks bent. In daily life the rate of visual perception is supremely important, and its dependence upon brightness levels still needs to be brought home to some lighting consumers.

I notice that the Hitchin Urban District Council has prepared a booklet of advice to tenants of the Council's houses, and this booklet includes some remarks on the subjective effects of colour in room decorations. Green is the colour of choice for a restful effect and blue is for peace. Brown is for concentration (I wonder if this was suggested to the compiler by the familiar expression "a brown study"?). Red is for stimulation, yellow for animation, and orange for cheerfulness. White or grey is said to be cheerless. Most psychologists agree that, as to their influence upon feeling, colours may be divided into two broad classes—"active" or "stimulating" (viz., red, orange and yellow), and "passive," "restful," or "depressing" (viz., greens and blues). One hopes, however, that the Hitchin tenants will appreciate some of the factors other than hue (e.g., area to be coloured, and the illuminant available) which have to be taken into account if a pleasing colour-scheme is to be obtained. Incidentally, some of the most cheerful rooms I have seen have been in "off-white," and not all greys can be said to be cheerless.

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## Authors Index



## Subject Index